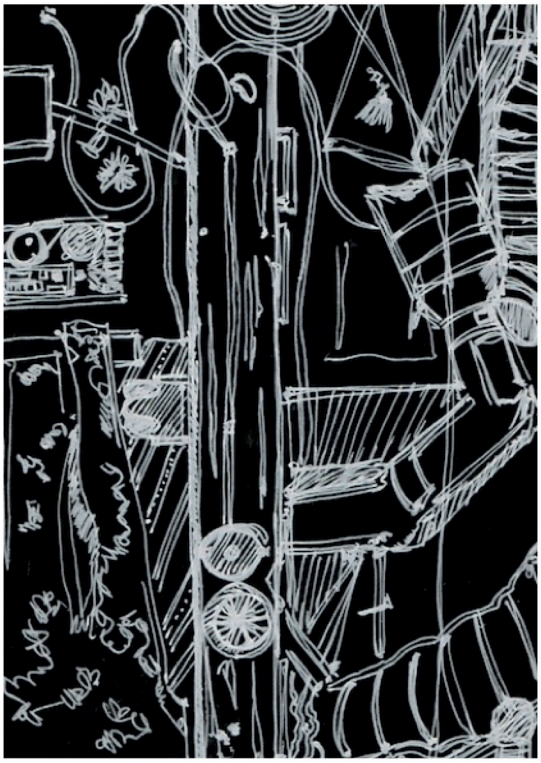
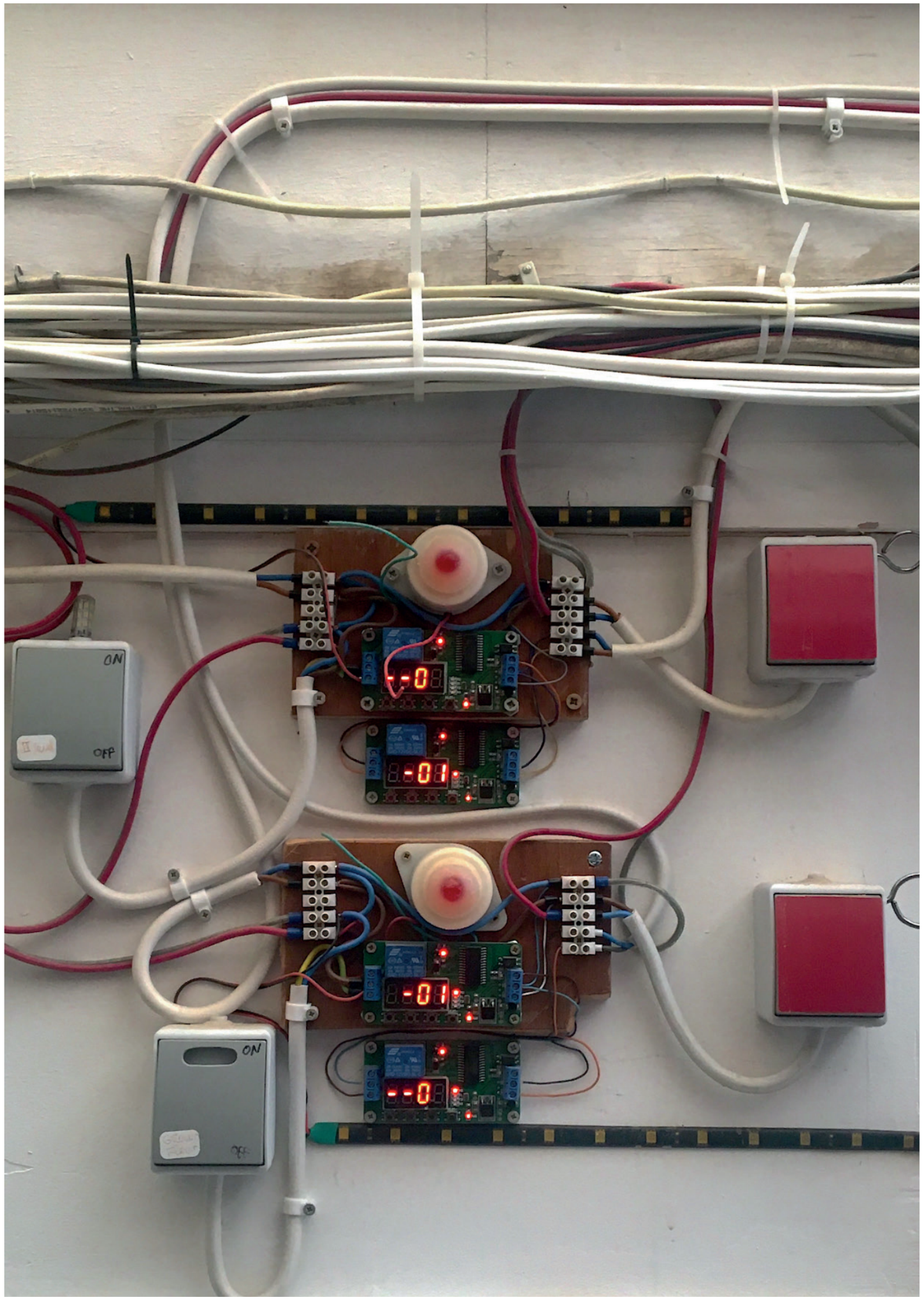


PAUL OSTROVERHY

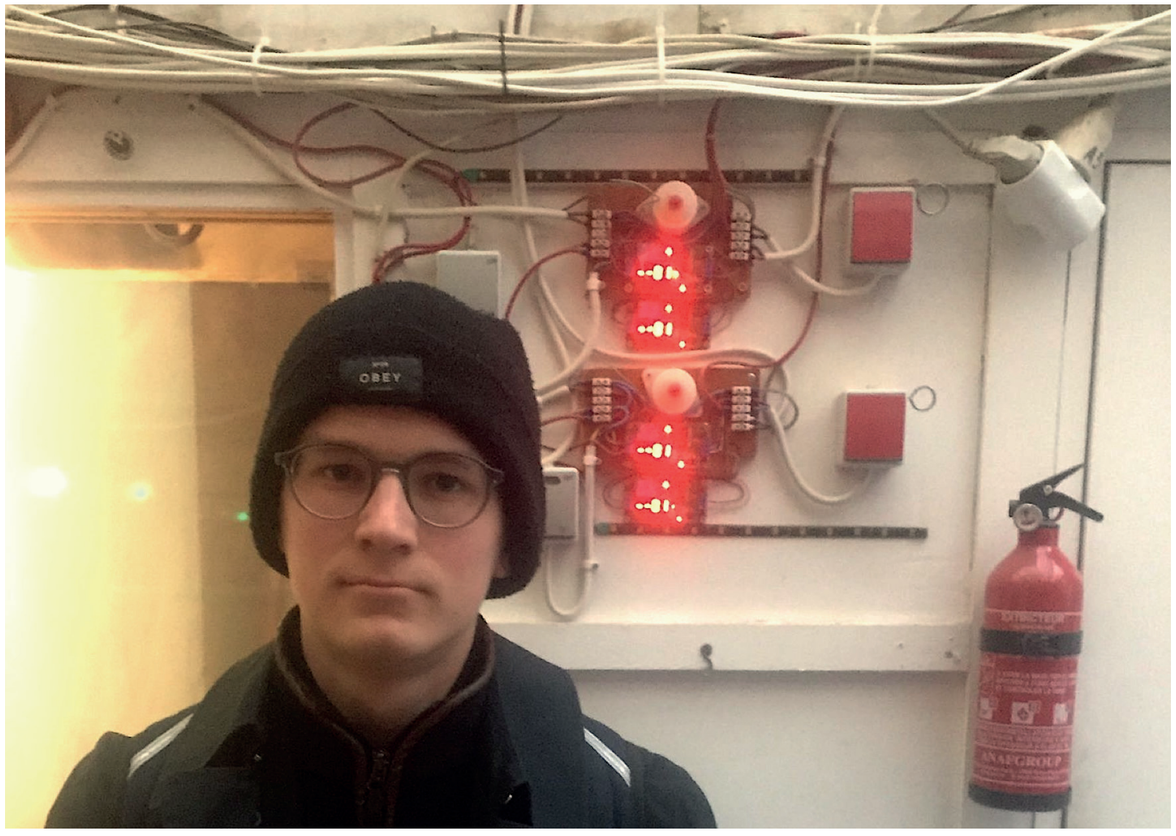


Paul OstroVerhy

Easter Holiday
Academic Internship Report
2023

LAB REPORT

PAUL OSTROVERHY'S TUTORED INTERNSHIP
IN BIOETHIC AND ELECTRONICS



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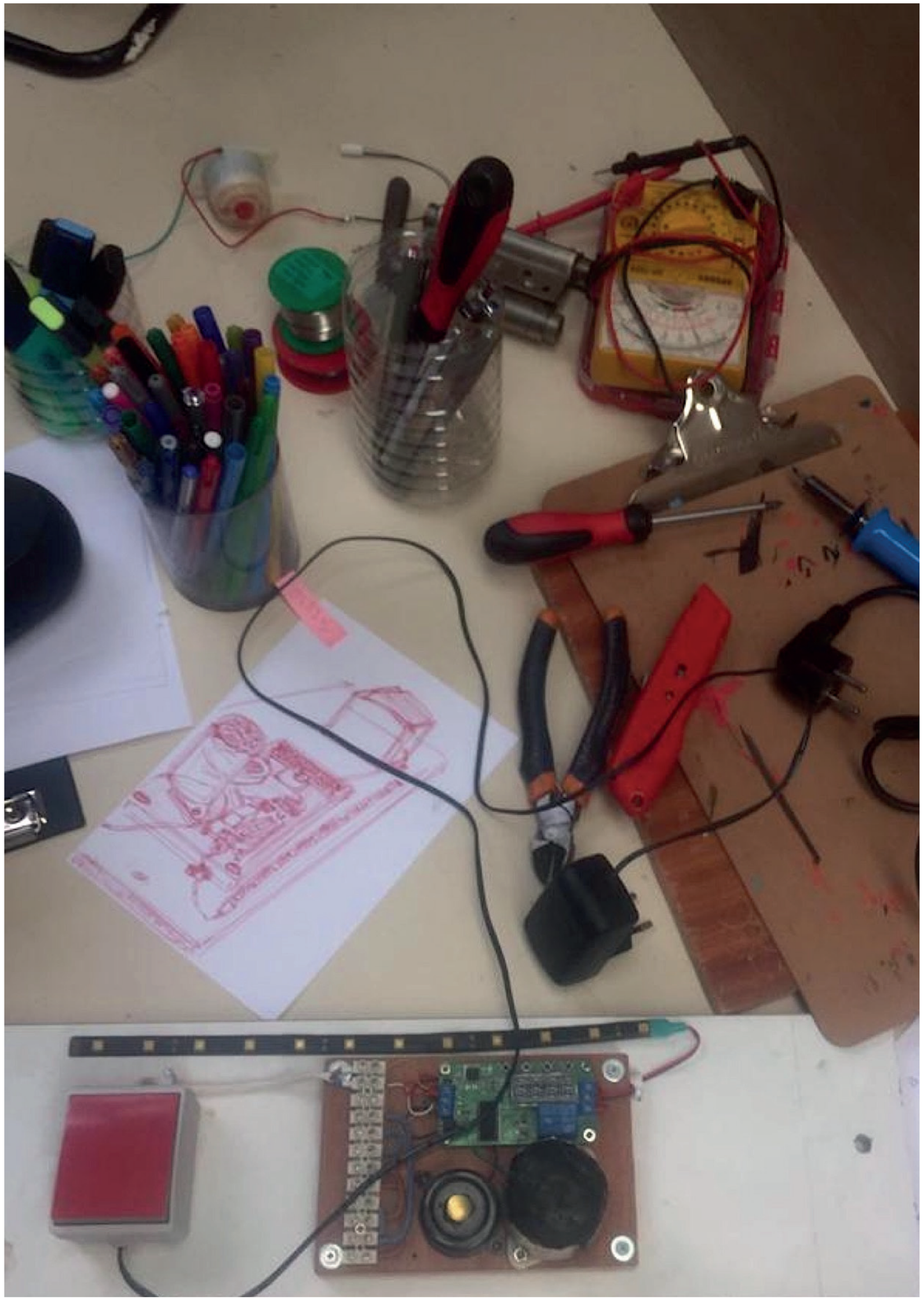


LAB REPORT:

Fire Alarm Reliability and Satisfaction

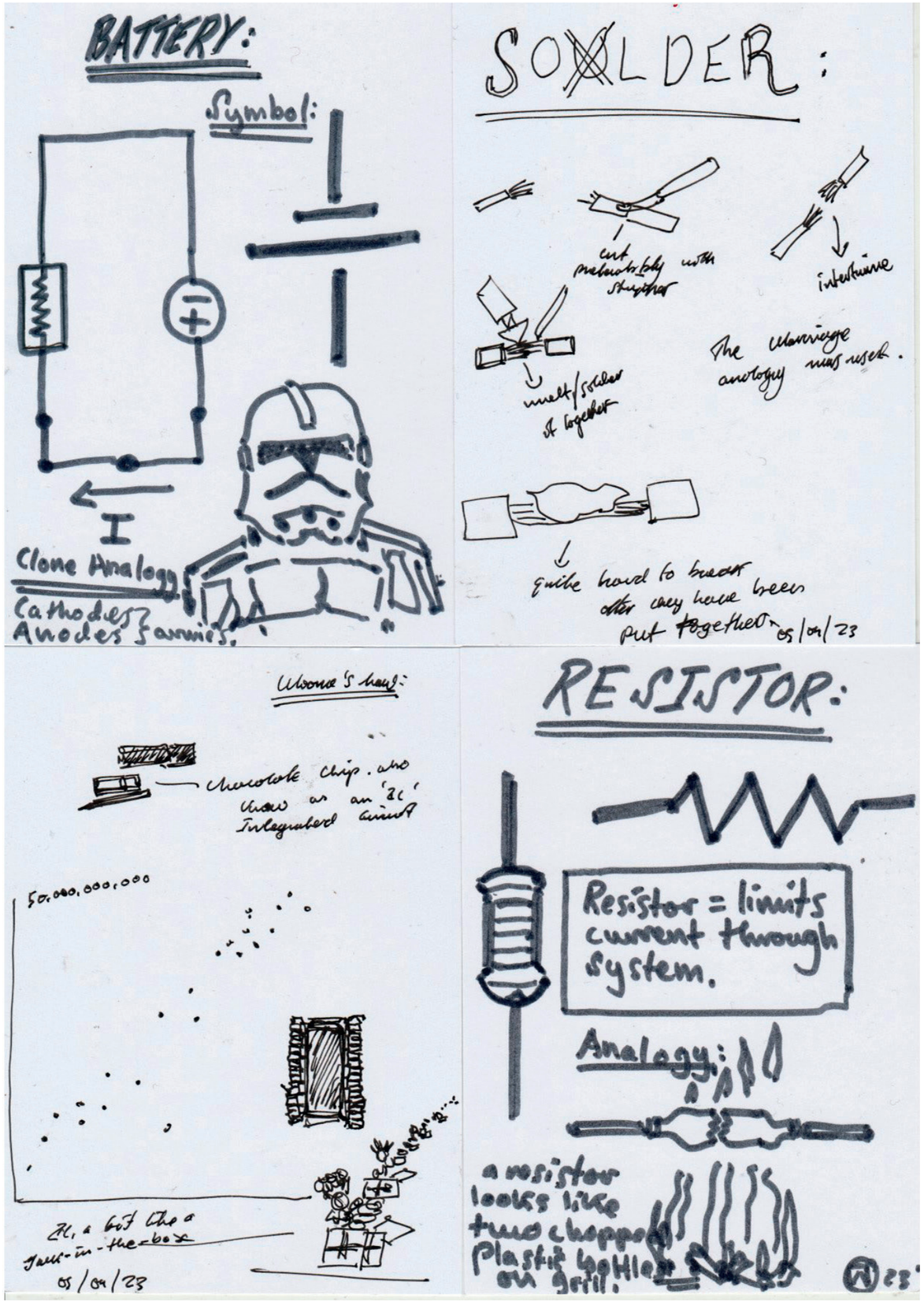
INTRODUCTION:

Homemade fire alarm systems are easier to be adapted to the specific demands of a particular house. In this context, a fire alarm system is not linked to smoke detection. An interview done with the creator of the homemade fire alarm system which we are investigating (see appendix) revealed that the homemade fire alarm system was first implemented twenty years ago. The creator told us that the sensitive nature of the previous commissioned fire alarm to burnt toast meant it consistently went off, resulting in numerous complaints from the neighbours. In response, with the help of an ex-aviation electrical engineer, a new non-automatic system was built within eight months. However, because it was created twenty years ago and does not contain the quality assurance of a standard factory-made fire alarm, we wanted to ensure that it still works effectively.

The purpose of this experiment is to ensure that people within the house are living in a secure environment that contains a homemade fire alarm system. Two experiments are going to be made: a quantitative and qualitative experiment. The former aims at quantifying the reliability of the homemade fire alarm system by measuring voltage and current at several fire alarm points in the house. The latter aims at surveying people in the house to find out their comfort level vis-a-vis the homemade fire alarm system. The dependent variable of the former has been determined as the fire alarm location, whilst the latter's dependent variable are the people surveyed. The hypothesis for the quantitative experiment is as follows: if we measure the voltage of the fire alarm points in the house on the top floor and bottom floor, the homemade fire alarm models on the top floor will be less reliable than the ones on the bottom floor. The hypothesis for the qualitative experiment is the following: if we survey people in the house, the response will indicate a unilaterally high comfort level with the homemade fire alarm system.

METHODS:

The following experiment will be done in the city of Paris, France. It will be conducted throughout April 2023. There are two parts of the experiment that are to be done separately. Both parts of the experiments concern the same fire alarm, which can be visually seen in the figure 1, 2 and 3 below. The fire alarm consists of a CE030 Multifunction Time Delay Relay Board, a switch, a power source, a red light, a sound emitter, connectors, light strip, wires, and two wooden boards attached to one another. Once the fire alarm is connected to a power source and the switch is subsequently turned on, the sound emitting device in the fire alarm fulfils its function of sonority due to the signal transmission being successful with the help of a connector. The beeping sound continues until it is eventually turned off. Meanwhile, the CE030 Multifunction Time Delay Relay Board puts on a timer of four minutes that can be visually seen. There is also a light strip that immediately emits a non-flashing green light. After four minutes a red light starts flashing and a louder, faster-beating beeper is turned on.



Part I: Quantitative Experiment

For each fire alarm station in the house, ensure that the fire alarm station is attached to a voltage source. The fire alarm station model can be visually seen in figures 1,2, and 3 below. There were 25 fire alarms, and Chat GPT randomly selected 10 of them. Figure 5 shows the rooms that have fire alarms, shaded in blue. Those shaded in blue were all numbered, and the rooms that were randomly selected for the experiment had their numbers circled in red. Fire alarm stations 6 and 11 were not tested despite being circled in red due to sabotage complaints

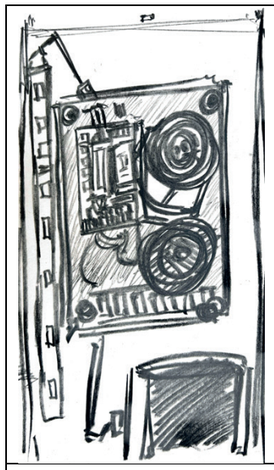


Fig. 2, 3 The principal investigator's artistic renderings of the homemade fire alarm system

Fig. 1 A photo of the homemade fire alarm system

Fig. 2, 3 The principal investigator's artistic renderings of the homemade fire alarm system

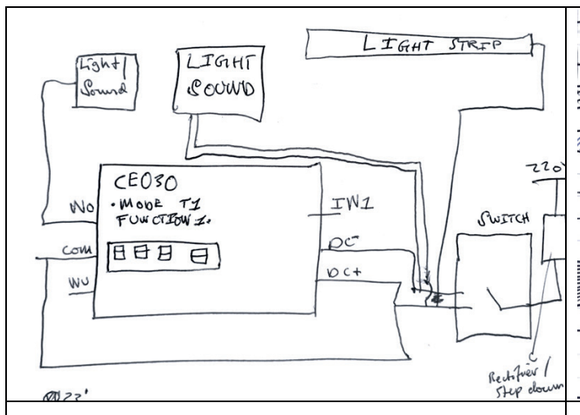


Fig. 4. Schematic of the homemade fire alarm.

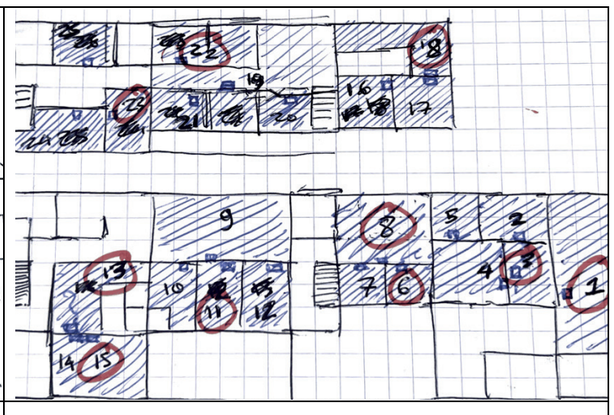
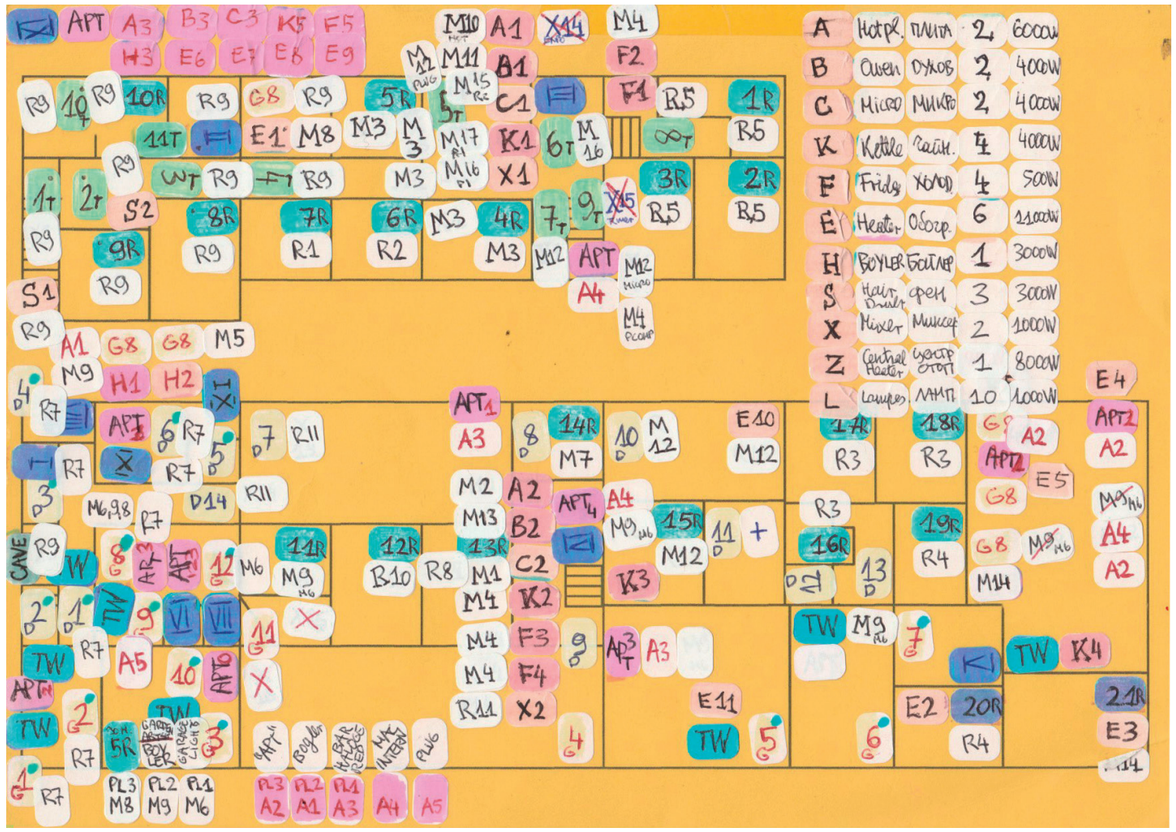


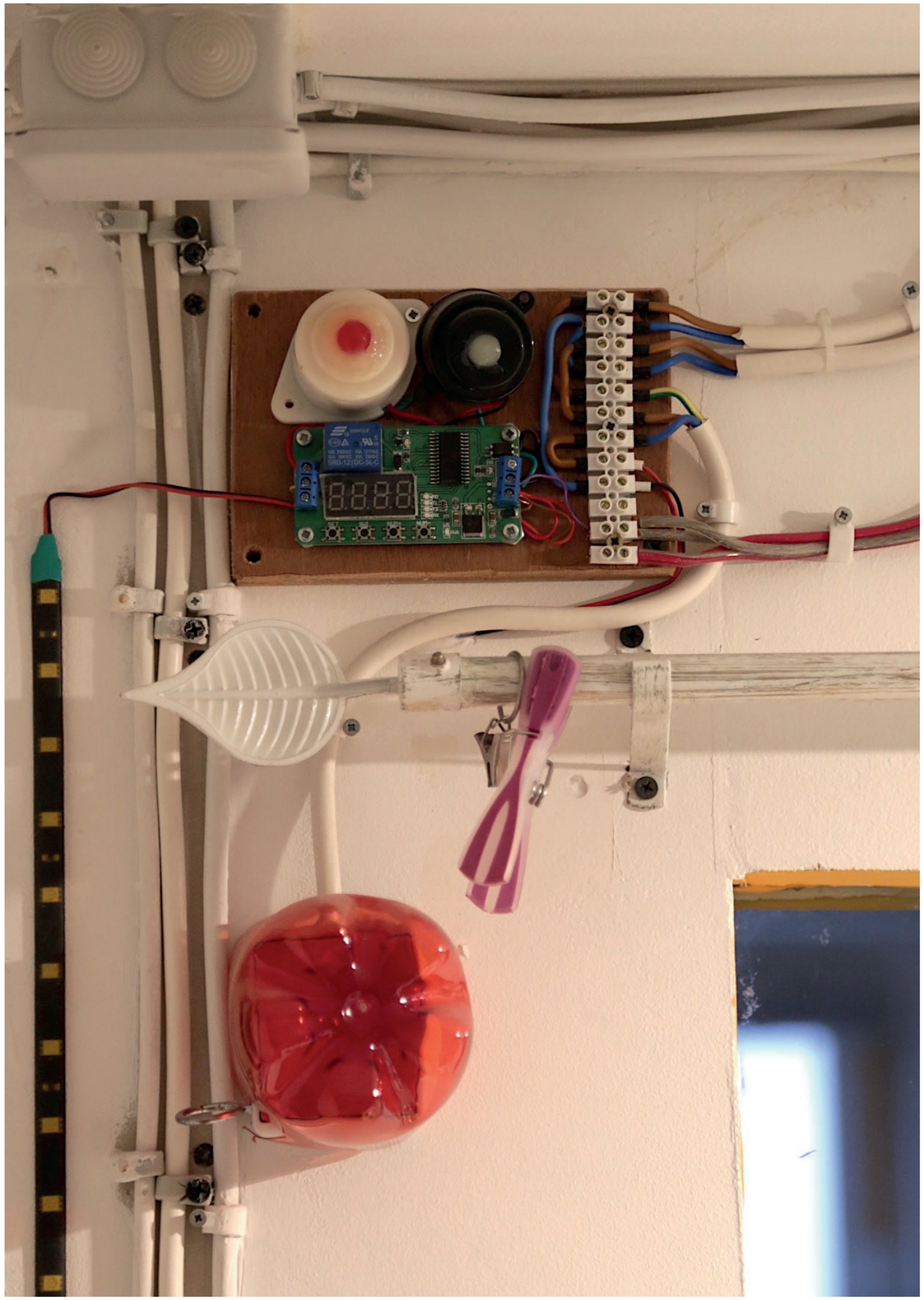
Fig. 5. Fire alarms, with those tested marked in red (alarms 6 and 11 were not tested).

We used a voltmeter with red and black probes to test each fire alarm station according to the points in Table 1. These were tested when the fire alarm was on. The test points are visually marked on the fire alarm. Figure 4, a schematic of the fire alarm station, also shows where the test points are. Whenever a particular fire alarm model is turned on, the voltage at each test point should be subsequently recorded on a written paper using a pen.

Test Point	Red	Black
A	DC+	DC-
B	NO	DC+
C	NO	DC-
D	DC-	Common

Table 1. Test points for the voltmeter.





Part II: Qualitative Experiment

Each person in the house should be given the same survey (Fig. 6) on a printed piece of paper. Each person should fully answer and complete the survey without the consultation nor help of a phone, person or any other tool, being, entity or item that may help them and hinder their results. We gave the survey to 9 people total.

Survey: General Satisfaction of the Homemade Fire Alarm System 14th of April 2023

Where are you from? .....
Gender: .....
Age: .....
Eye Colour: .....

1. On a scale of one to five, how safe do you feel living with a homemade fire alarm system.

   1 2 3 4 5

2. With four smiley faces, which one corresponds to how you feel living with a homemade fire alarm system.

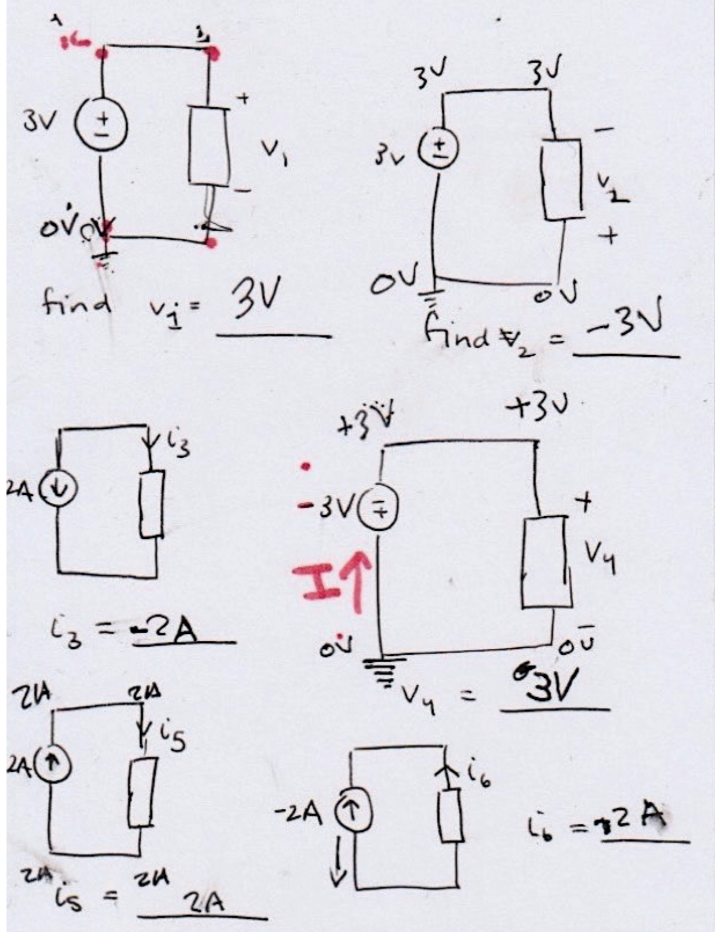
3. Does this photo of a homemade fire alarm system make you unsure of its effectiveness? Yes / No

4. Do you have trust in the homemade fire alarm system? Yes / No
5. Have you been in a fire situation in the past? Yes / No
6. Do you worship fire? Yes / No
7. Would you rather have a factory-built fire alarm system and suffer its devastating consequences of being over-sensitive to toast or keep the status quo? Yes / No
8. What do you think could be made better? Write response below.
   .....
   .....
   .....
   .....
9. Are you aware of how the fire alarm system station functions? Yes / No
10. On a scale of one to five, how happy would you feel in a fire situation?

    1 2 3 4 5

Figure 6. Survey handed out to people to be completed.

Practice



POWER

power = GOD – "Paul"

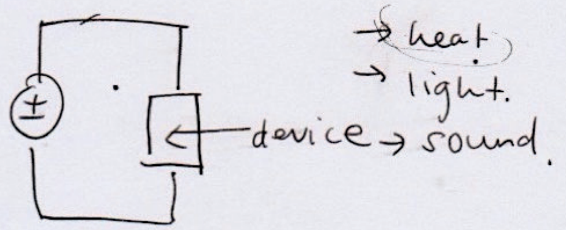
"It cannot be seen"

"but it can be felt"

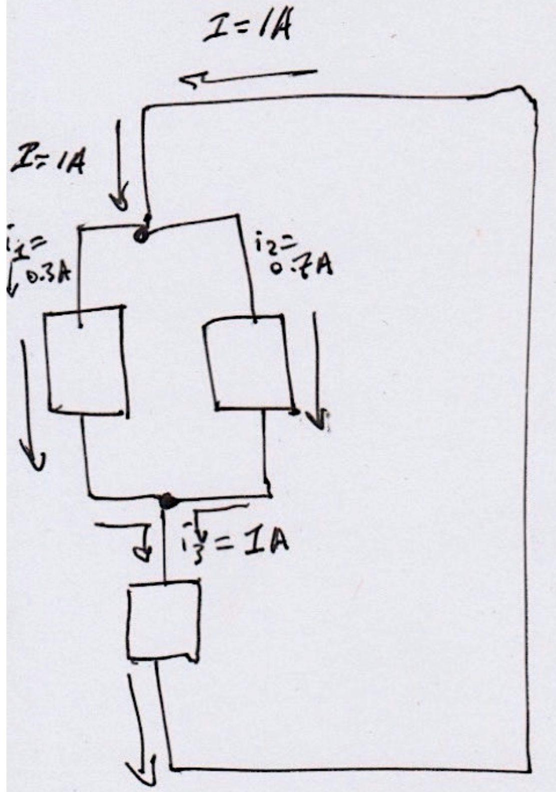
* energy lost/sec by the circuit *

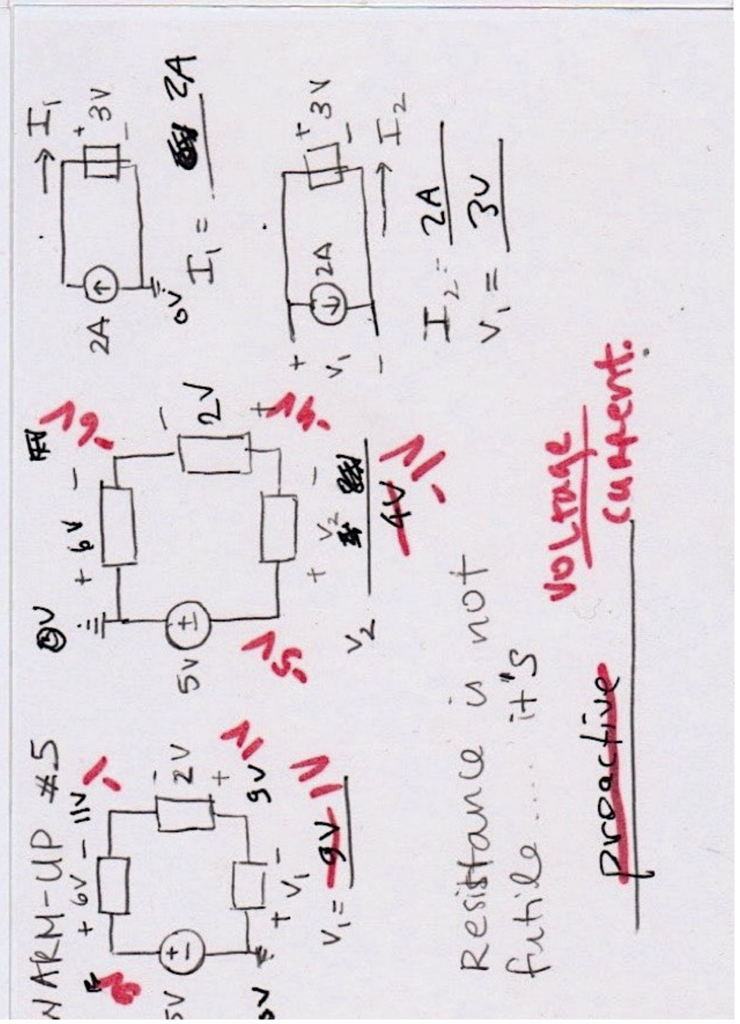
→ P = IV

ENERGY IS CONSERVED

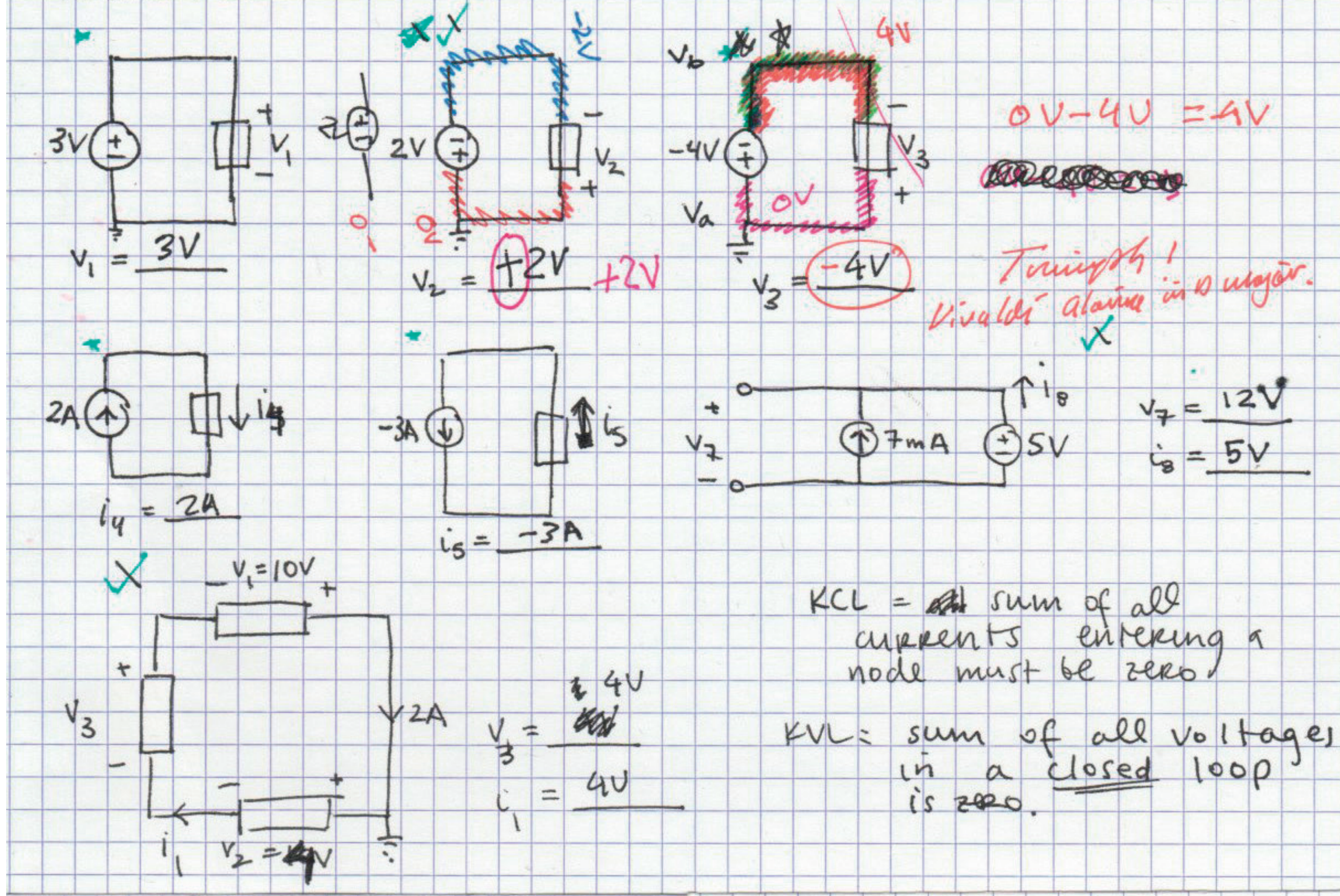


Electronics: Circuits:



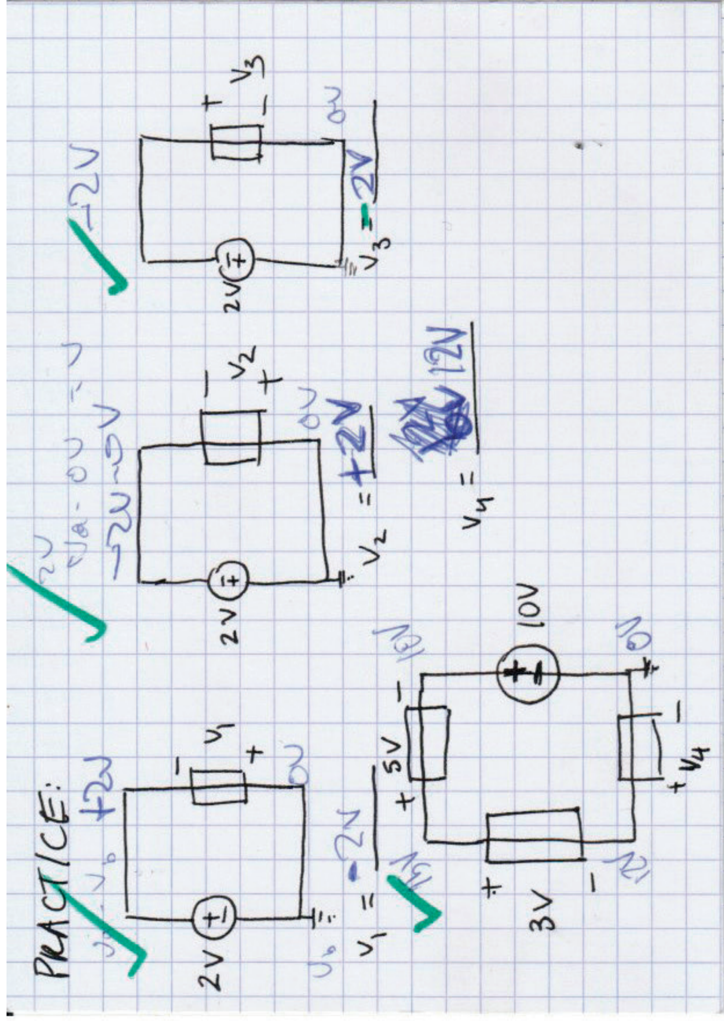


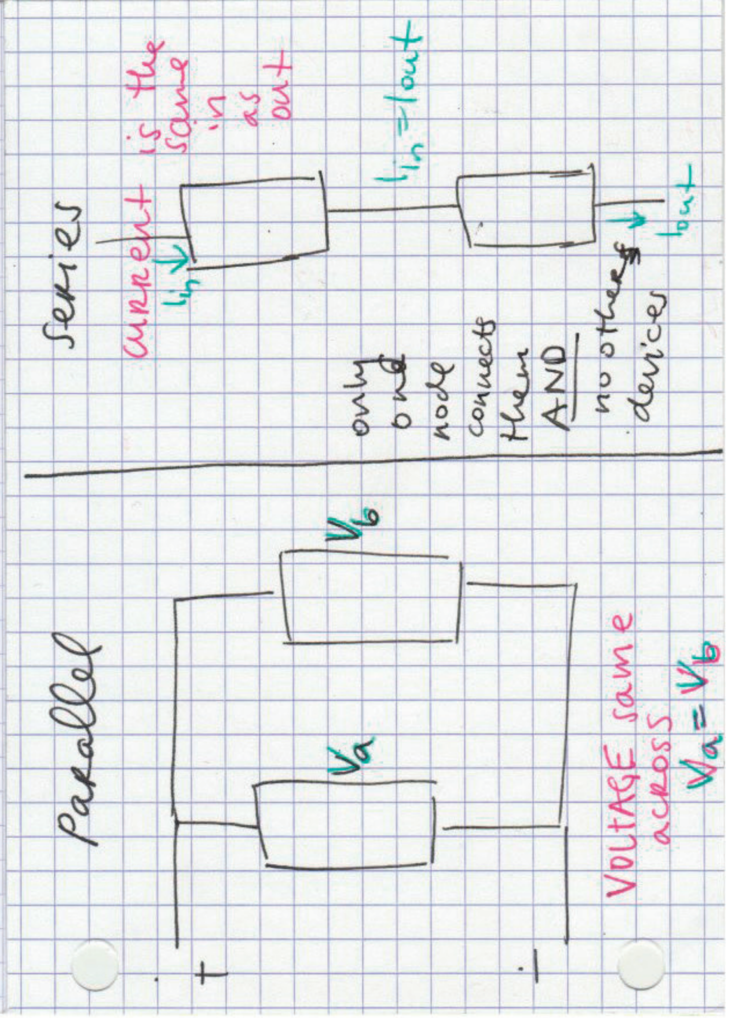
PRACTICE

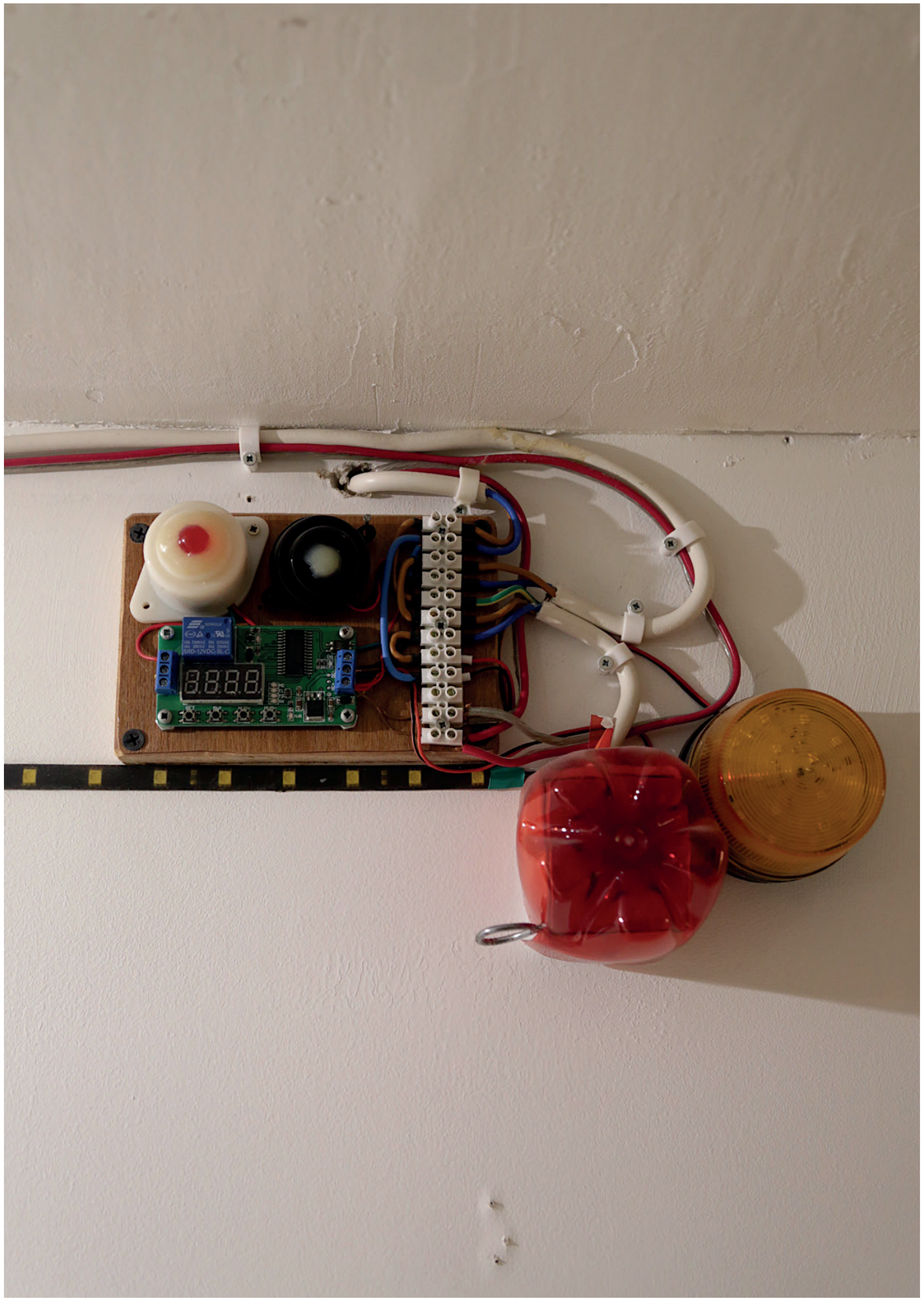


KCL = sum of all currents entering a node must be zero.

KVL = sum of all voltages in a closed loop is zero.





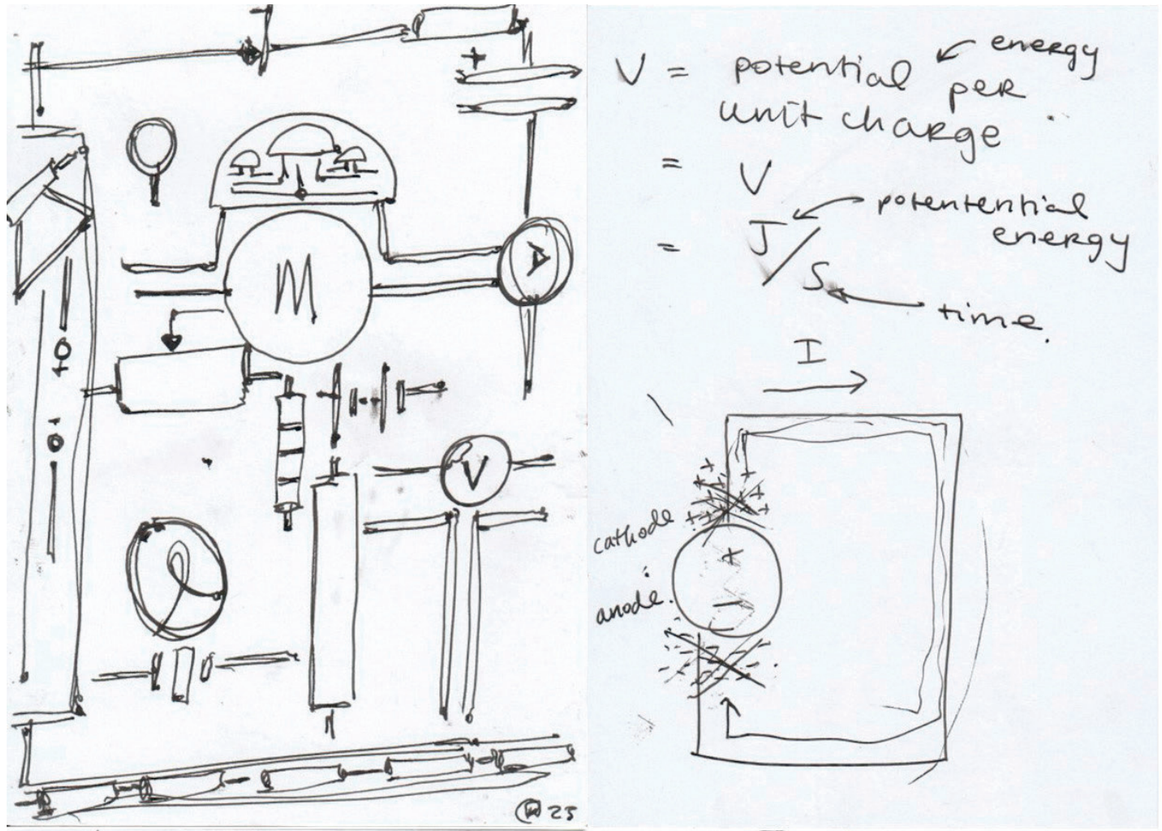


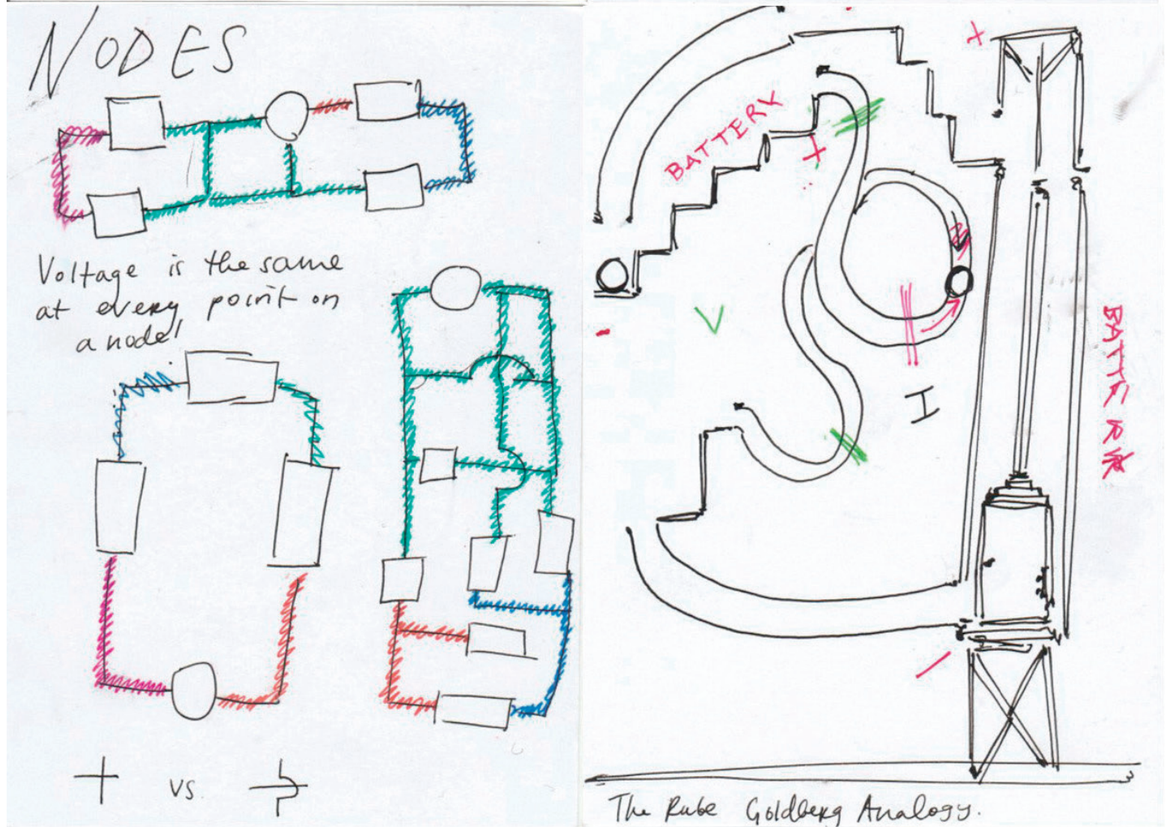
RESULTS:

Table 2 was made following the testing of the selected fire alarm stations' voltage with a voltmeter when they were turned on. Table 3 was created to see the average, average without outliers and range of the four test points. We spotted two outliers on test point B and C on location 15, both being 0 volts. We spotted an anomaly on test point C in which the result kept decreasing at a gradual pace mostly starting from a range of 0.30-0.34 volts.

Locations	Voltage at A	Voltage at B	Voltage at C	Voltage at D	Observations:
1 (Bottom floor)	10.49	-9.97	0.34 then gradually decreasing	-10.47	The second alarm was turned on after a countdown from 6 minutes, very interesting. More messy wires, on top of the door, rather clean but different sound/light model.
3 (Bottom Floor)	10.25	-9.72	0.31 then going down gradually, it's all a bit vague at the start.	-10.27	It's one of the normal models, nothing too spectacular.
8 (Bottom Floor)	10.64	-10.23	0.34 then going down gradually, why is it so close to 0.34 always. This is very strange.	-10.62	Lots of wires, looks older, it's a bit of a mess really, because there is so much dust on top of the red switch that it got glued to the switch itself. This is abysmal.
13 (Bottom Floor)	11.28	-10.75	0.34 going downwards gradually.	-11.25	No switch for this one. The switch to turn it on is the red one connected to the ground floor general which in turns has a wire going to the garage one
15 (Bottom Floor)	11.48	0.00	0.00	-11.45	Very very strange results for the second one. This is the general fire alarm for the ground floor. Ping Pong room for ground floor general, measured with switch turning on being the general one.
23 (Top Floor)	11.23	-10.68	0.33 and then decreased slowly. Don't actually know when it stops.	-11.21	It's a normal one. It's our model that's quite an exception, but there was the Badoit here cut quite short.
22 (Top Floor)	10.91	-10.33	0.30 and decreased slowly. Was at 0.13 when we turned it off. But no probe on it resulted in no lowering of numbers. "Weird, right?" Helen. "Keep an eye on that one?" Helen.	-10.88	Less dirt, more wires, different light sound model, switch is below. The powersource comes in two wires too, but one wire is actually two wires stuck together.
18 (Top Floor)	10.71	-10.13	0.36 fluctuated a little but the usual gradual going down.	-10.73	Looks in good order, quite clean and new. Although the switch is rather far away, beside the door way down in contrast the alarm is above the door entrance.

Table 2. The voltage results of each fire alarm station tested and observations.





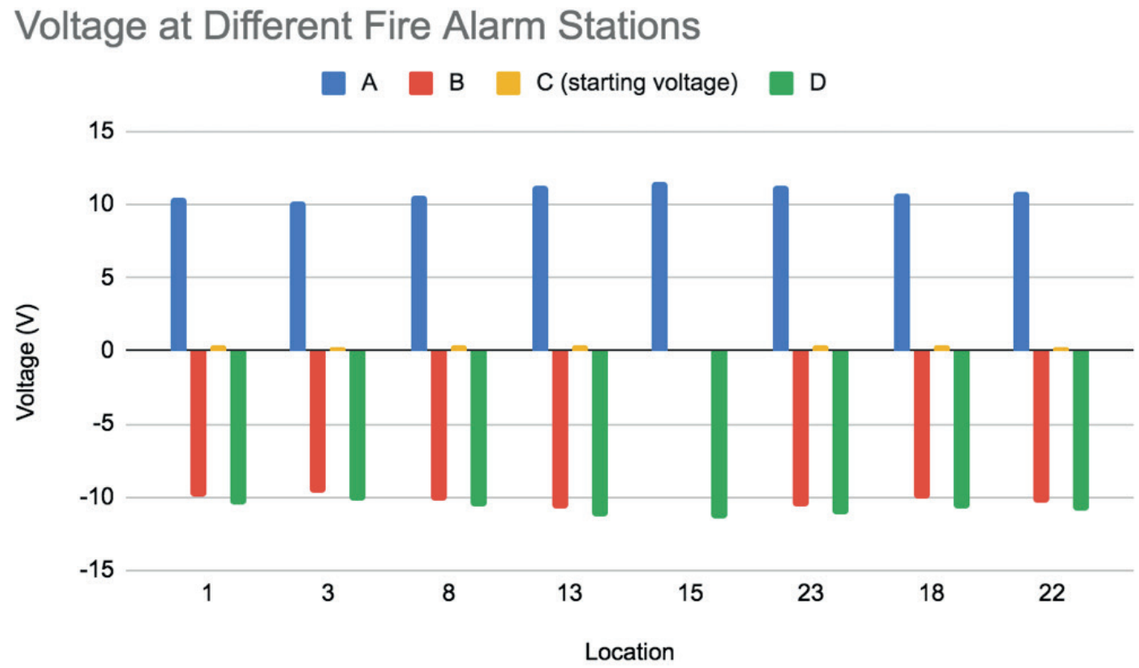
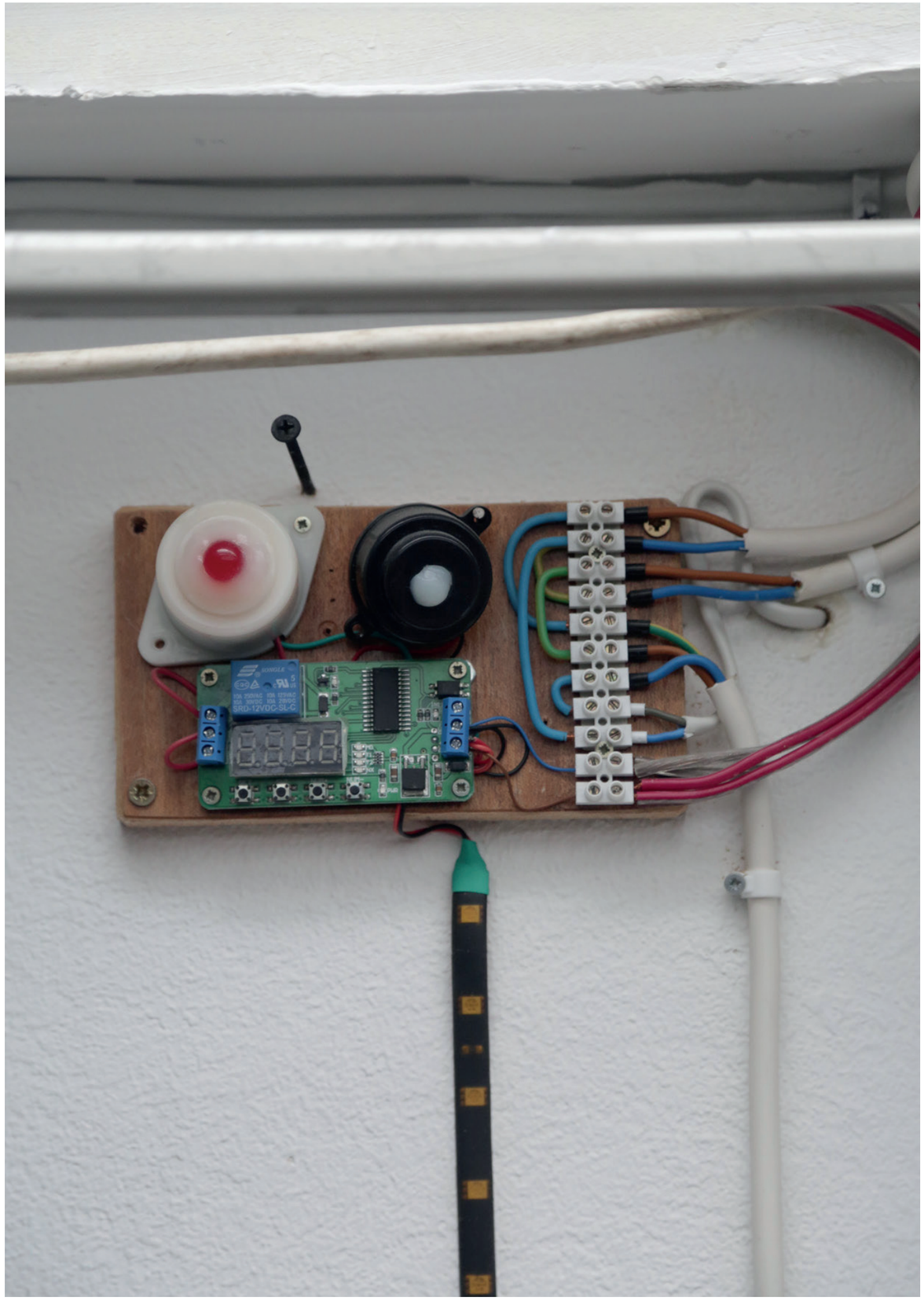


Figure 6. Bar Chart showing voltage at different fire alarm stations.

	A (Voltage)	B (Voltage)	C (Voltage)	D (Voltage)
Average	10.87	-8.98	0.29	-10.86
Average (no outliers)	10.87	-10.26	0.33	-10.86
Range (no outliers)	1.23	1.03	0.06	1.18

Table 3. Table showing the average, average without outliers and range of each test point.

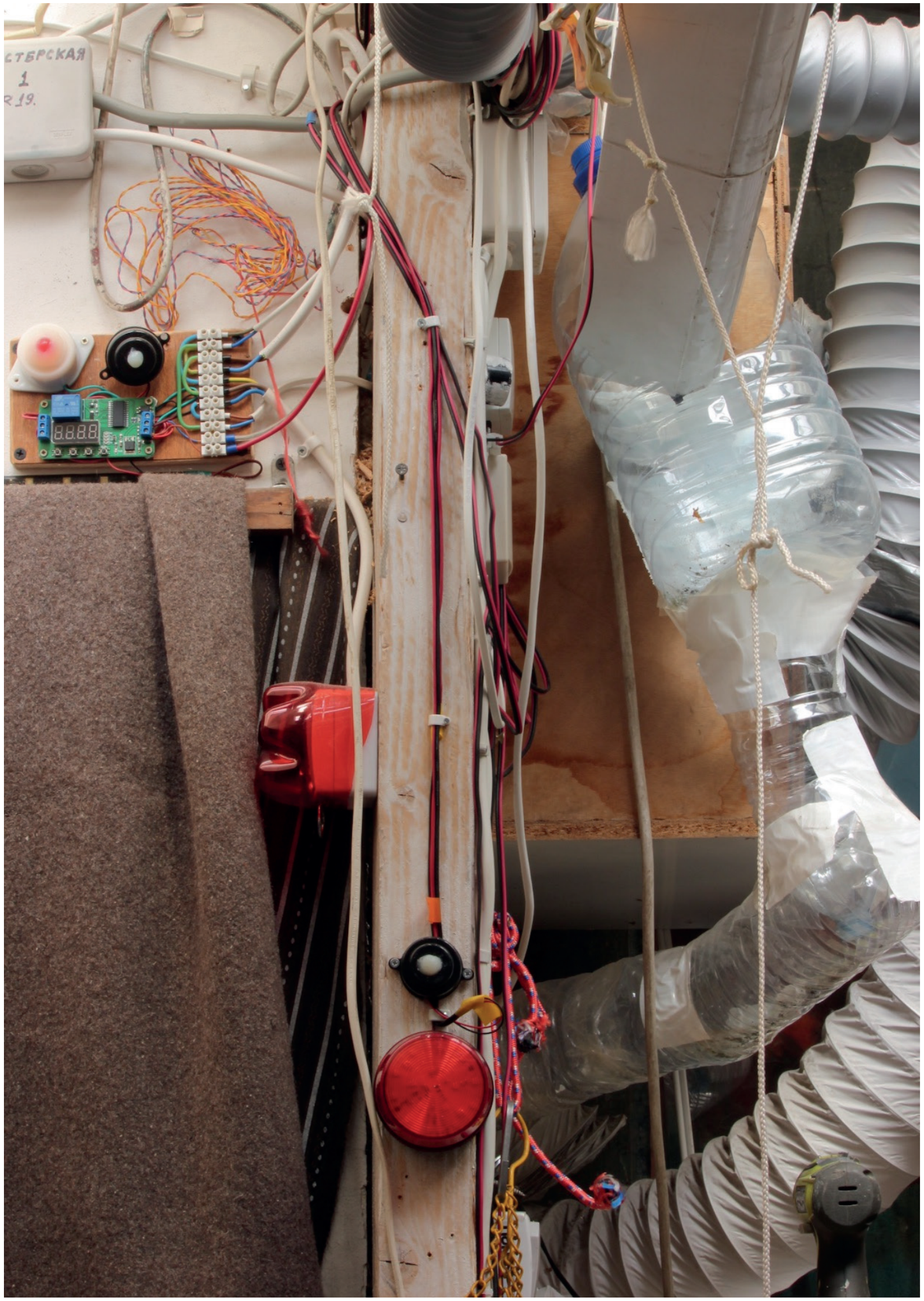
Table 4 was created to show the results of the survey's responses. There was an outlier in question no. 6 in which one person said they worshipped fire. That same person had significant trust and high satisfaction in the home made fire alarm system. In worshipping fire, they stated that they would feel very happy in a fire situation. Two people said they would feel extremely happy in a fire situation, whilst the overwhelming majority stated they would feel unhappy and deeply unhappy. Two people felt unhappy living within a homemade fire alarm system whilst the majority said they were happy and greatly happy. One person said they did not have trust in the homemade fire alarm system whilst every other person said they had. One person had eyes of different colour. The average for safety was 4.22 out of 5, suggesting a high sense of safety living within a homemade fire alarm system. The average satisfaction of living within a homemade fire alarm system was 3.44 out of 4, suggesting a high sense of satisfaction. The average to how happy a person would feel within a fire situation was 2.22 out of 5, suggesting only a minority would feel happy in a fire situation.



Question	Person 1	Person 2	Person 3	Person 4	Person 5	Person 6	Person 7	Person 8	Person 9
From?	Germany	Canada	Ukraine	Russia	France	Russia	Ireland	USA	UK
Gender:	F	M	M	M	F	M	F	F	F
Age:	18	20	58	24	52	22	31	24	28
Eye Colour:	Brown	Brown	Vairons	Blue	Green	Brown	Green	Green	Blue
1 Safety	4	5	5	5	5	5	3	3	3
2 Satisfaction	Light Green	Super Green	Super Green	Super Green	Super Green	Super Green	Super Green	Light Red	Light Red
3 Photo	No	No	Yes	Yes	Yes	No	No	Yes	Yes
4 Trust	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
5 Past fire	No	No	Yes	No	Yes	Yes	Yes	No	No
6 Worship	No	No	Yes	No	No	No	No	No	No
7 Status quo	Yes	No	Yes	No	The status quo?	Status quo	Keep the status quo?	Yes	No
8. Suggestions	It's probably great how it is. The wires being out probably scares some people though.		Maybe to introduce again as it was, before: a phone call on every person's mobile the signal	No	Fire Extinguishers	I think that what could be made better is fire exit	In terms of preventing a fire. I think the sockets of the Territory should not be overloaded. While in relation to the fire alarm system. It should be tested once every 2 months.	A smoke detector.	Some way to detect smoke in case someone was not at home to see press the button.
9. Functions	Yes	No	Yes	Yes	No	Yes	No	Yes	No
10. Happiness in fire	2 (Cause I get to see it in action only)	1	5	5	1	2	2	1	1

Table 4. All the survey responses collected in a data sheet.

Table 5. Table showing a correlation between past fire situations and sense of safety in HFAS.



DISCUSSION:

Part I: Quantitative Experiment

Several anomalies were found in the collected data. All test points C had an anomaly in which they decreased in voltage, which could suggest it is a normal behaviour. However, it could also have come from the fact that we leeched voltage through the probe, or it could have been an inductor in the light/sound device causing the voltage to decrease exponentially. Another outlier was that test points B and C were 0 volts for location 15. This could come from the fact that location 15 was a different design than other stations within the fire alarm system, since it was the general fire alarm station regulating the whole bottom floor. It also could have been broken or simply a scientist error. Finally, the dust on top of the switch for location 8 was so settled that it was impossible to scrape off. The older version of the fire alarm station and the excessive dust suggest that it was used less and therefore might have become unfit.

The stated hypothesis was wrong because the top floor was not less reliable than the bottom floor. In fact, more anomalies were spotted on the bottom floor than the top floor. This could suggest that the top floor's fire alarms are newer and more reliable since it learnt from the trial-and-error of the first alarms implemented on the bottom floor. Calculating the range of each test point, the top floor had on average a smaller range than the bottom floor. The top floor's ranges for test point A, B, C and D were: 0.52 V, 0.55 V, 0.06 V and 0.48 V. The average was thus 0.49 V. In contrast, the bottom floor's range for test point A, B, C and D were: 1.23 V, 1.03 V (without the outlier), 0.06 V (without the outlier) and 1.18 V, thus making an average range of 1.17 V. We propose that the greater the range the lesser the reliability due to increased inconsistency. Therefore the bottom floor has overall less reliability.

Part II: Qualitative experiment

We also spotted some strange anomalies within the survey results. 22% of respondents said they felt extremely happy in a fire situation, whilst 78% of respondents said they would feel unhappy and deeply unhappy. Perhaps this small minority who would feel happy have a firefighter past and thus they would know how to respond or feel nostalgic. This is something to be tested next time. 11% of respondents stated that they had no trust in the homemade fire alarm system and that they would rather abolish the status quo because they would be uncomfortable in a fire situation. There was a correlation found between people in past fire situations and how comfortable they felt within a homemade fire alarm system. 56% of respondents were in a past fire situation and this same group would on average keep the homemade fire alarm system rather than switch it to factory-made. Does this suggest people with a past fire situation experience are now less trustworthy of factory-made fire alarms rather than a homemade model? This is something to research in the future. Only one person stated having eyes of different colour and that same person professed in both worshipping fire and having great happiness in being within a fire situation. Though data does not suggest a correlation, it is still worth exploring further next time. The hypothesis was partially correct, because whilst there was no unilateral high comfort living within the homemade fire alarm system, the average for satisfaction was 3.44 out of 4. This suggested a certain level of comfort living with a homemade fire alarm system.

Conclusion:

Of the two experiments on the homemade fire alarm system, the hypothesis for the quantitative experiment was proven wrong. The hypothesis had been that the top floor's reliability would be greater than the bottom floor in terms of voltage. It proved to be the other way around, with more anomalies and a greater range on the bottom floor suggesting more inconsistency and therefore less reliability. Our second hypothesis was partially correct, as most respondents had on average great satisfaction with the fire system which reflects a high standard of comfort.

However, there were several limitations and sources of error. Time constraint was the greatest as it meant that some experiments were rushed and therefore had bigger risks of human error. The repeated noise of the fire alarm within the house created several noise complaints and in the pursuit of minimising complaints it meant that not everything could be done with ease. The lack of knowledge in the overall fire system wiring was another significant factor because it could have been the source of some anomalies. In tampering with the system, the scientist received complaints resulting in two locations not being tested. Next time, more knowledge in the wiring system would create greater accuracy. Another limitation factor was the linguistic barrier between survey respondents, which meant some survey responses were not as accurate as they could have been. In the future, writing surveys in the necessary languages would optimise accuracy. Human error was also inevitable. In subsequent experiments, the survey could add questions on the topic of military or fire-fighting background.

There were several typing mistakes in the survey that should also be adjusted. In the end, a lack of knowledge in how the system works could have been the source of unhappiness and a lack of trust in the system. This lab report showed me how external factors can have a deep influence on the results of the experiments. Despite time constraints, my motivation has been boosted as I discovered a new found love in collecting and translating data into charts.

APPENDIX

Interview: 12th of April 2023

Why exactly did you choose a homemade fire system of an already existing version from a store and when was this first implemented?

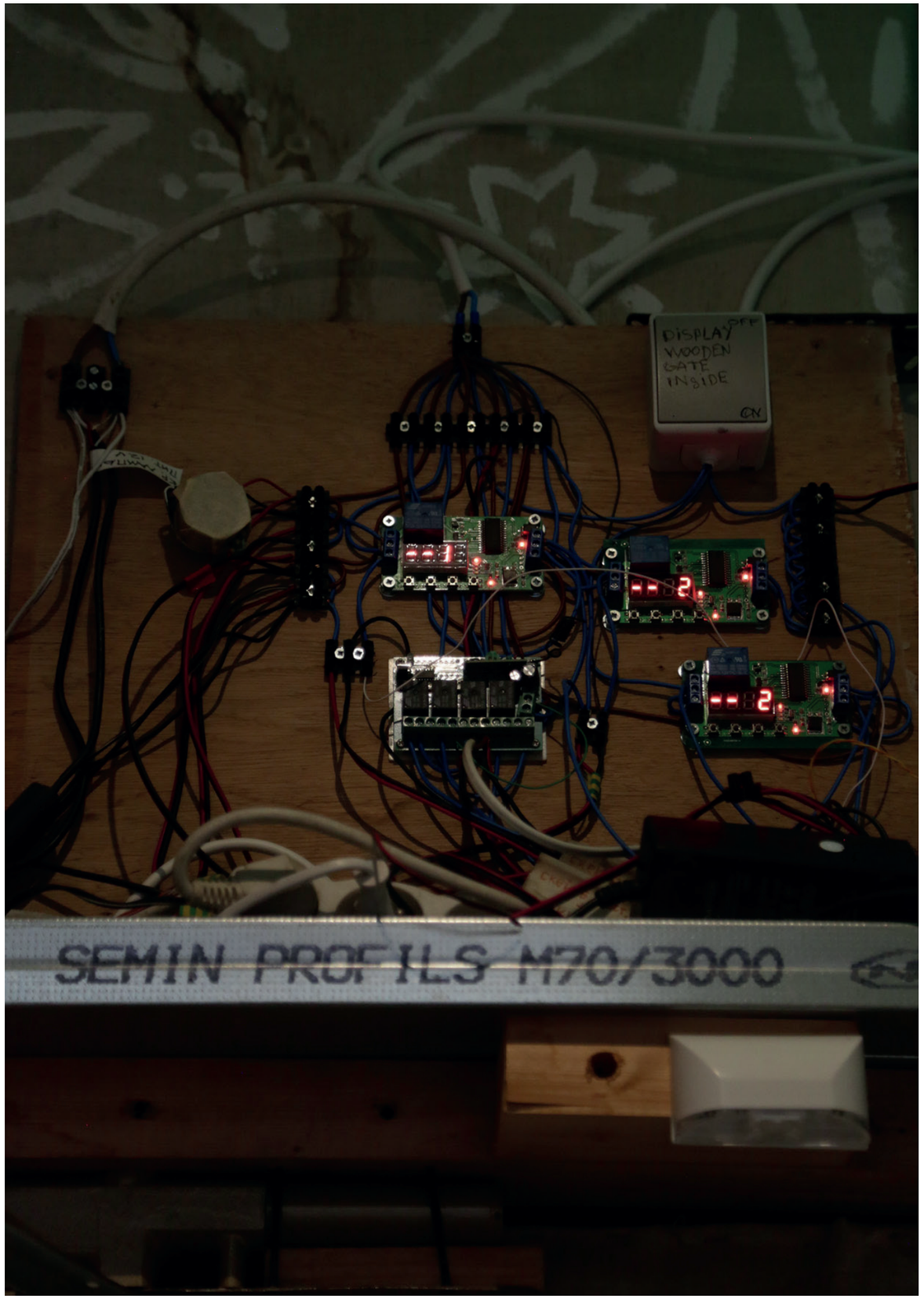
Sergio: *Well, let's say twenty years ago, I bought a very expensive German fire alarm system which was linked to the smoke detectors and whenever someone wanted to have a toast, it started to ring everywhere and extremely loudly. This disturbed my neighbours creating a highly uncomfortable situation in my structure which we could call a Parisian art commune. So, we needed a system, a structure, a fire alarm, which was adapted to the specific needs which we required in order: on the one hand not disturb the neighbours and on the other hand, the sound had to be regulated to our needs from a third point. It didn't have to be linked necessarily to the smoke detector. It had to be also linked to a manual activation by any member of the community in any space.*

When it was first made was it built collectively within a team or was it just you individually? Did you seek any consultation or help to build this manual fire system?

Sergio: *Well, I have a very precise idea what are the requirements I need so regulating the sound was the first point. Second point we also had to have a light which was activated. Let's say someone was sleeping in bed and someone in another space activated by pressing a button the fire alarm. Then that other person who was sleeping had to not only hear the fire alarm, which let's say in the case of a Bohemian artistic community could not happen due to the presence of a certain amount of alcohol in the blood of that person… they also had to see. In the room there was a strong light which started to flash. In addition, our homemade fire alarm was made in such a way that we could regulate the first minute when it gave a first alarm, and after the first minute there was a second alarm and a second light which started to flash which definitely gave the signal to everyone that now it's really time to get out, now it's really time to throw everything you have in your hands and just run. There was this necessity of having a double step by step fire alarm.*

Did the homemade fire alarm system cost more? Was the cost better than if you would have gotten an alternative version?

Sergio: *Yes, indeed the first fire alarm costed us five thousand euros while the second fire alarm system costed us mainly not really in materials because to buy the wires, the lamps, the special beepers which normally cars or vans were using, like a beeper when a car started to go backwards or a bus. The main cost for the second fire alarm was to pay the specialist, a worker who was an electric engineer, all kinds of electric engineering. He was an ex-aviation engineer who worked for me which meant he had some very specific understanding about electronics and because he was working for me anyway it was just in the frame of his daily assignment. However, to construct it, it took us several months. So, in the end I'm not even sure if it cost me less than 5000. Maybe it cost more, maybe it cost me 8000 because if he worked several months… I would not say that the price was cheaper however the requirements were met. We were definitely happy with the result because it is definitely still working fine. We could install it in every communal and private space. Our version has this option that makes it able to be regulated. We can regulate the sound… the step-by-step situation. Also, it's very visual, lovely, artistic, Bohemian so aesthetically speaking it's very pleasant to look at, like it has this funky-punky corky science-fiction look about it.*



Were there any particular cases where the homemade fire system had technical incidents? Any past problems or any particular instances where it came in handy or delivered failure?

Sergio: *Not really. It always worked fine and I don't see any incidents I can remember; it's still working fine. I think the only accident we have with this system is that initially we constructed in such a way that in case the power goes off it still works from a car accumulator, a kind of car battery, for like a few hours I guess, but somehow, I think the only technical issue we have is in case the electricity goes off … then the fire alarm goes off once we put back the electric system to work. So, if there is no electric power for any reason, let's say the electric company cuts the power off which sometimes happens in France in summer when it's too hot, then we turn back the general fuse and the fire alarm goes off. So, this is something to see why it happens.*

Were there any complaints or concerns from the people that happened to live within this homemade fire alarm system?

Sergio: *Not really. The only tricky situation which we sometimes had but that we resolved quite quickly is that the button to turn it on looks the same as an electric switch. So, we painted it in red and put inside a metallic ring so that you can't push it accidentally thinking that it's the light. We also bought some Badoit, French mineral water bottles of transparent red plastic, cut it in half and put it on the switch to indicate it wasn't to be used for switching on or off the light. So, in reality I do not think any of the users and art assistants who lived here were complaining about them because it was very simple to use, very simple to explain and accidentally nobody really pushed it. To be honest it was quite a big psychological reassurance as for me, as for everyone else to see this system working. I forget to say that in addition, we created a system in such a way that the sides have a flashing light and a sonority advertisement in every space. We could also see a special yellow flashing light outside of that space where that button was pushed. So, it was easy to locate where the problem was starting to happen if somebody was pushing a button. It was incorporated in the fire alarm system in every space that yellow light was inside as outside of these spaces so that we could locate them immediately just running through the corridors and seeing where the light was flashing.*

Were there any other fire security devices used to help with the fire alarm system?

Sergio: *Yes. The homemade fire alarm system was linked with all kinds of fire security situations which we created. For example, under each fire alarm system we had a small bucket of sand, a fire extinguisher and a fire alarm instructions and exercises. Initially we also had walkie talkies in every space on a battery (and charger) meaning it was always on and we could just also announce that there is an urgency.*

As a last point, did you put into practice any knowledge that you took from your firefighter past to make this home fire structure safer and more effective?

Sergio: *Yes indeed. My firefighter past helped me realise how important it is to create systems which are accessible and which people can use. For instance, the small sand buckets could be used very easily by young people who would initially be a little bit shocked or hesitant to use a fire extinguisher. Let's say it's an oil fire or even a very small cigarette fire a small bucket of sand could be poured on it to have psychologically easier ways for the person.*

PAUL OSTROVERHY

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